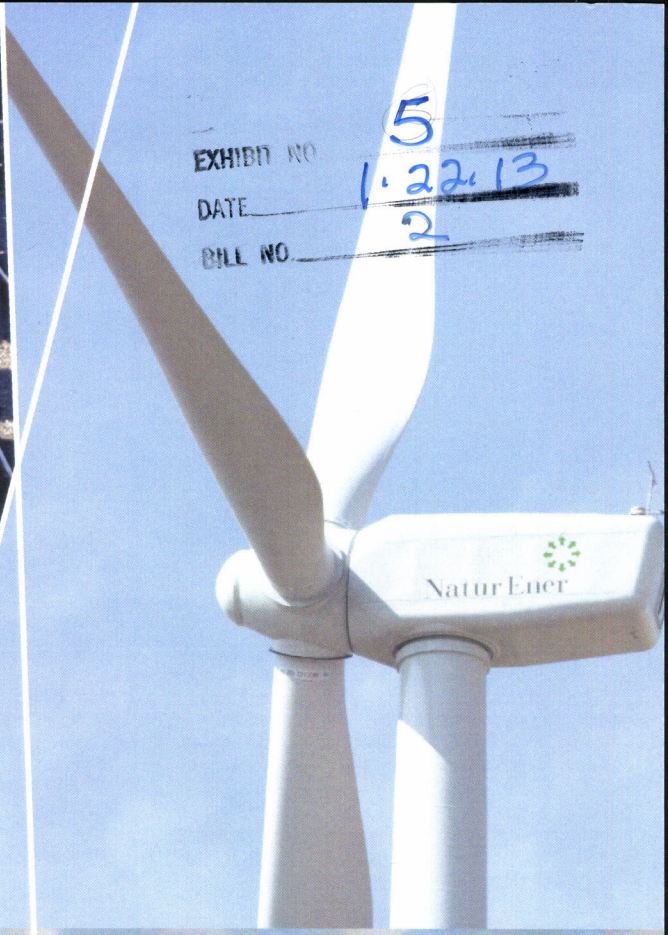

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Economics of Energy Development

A Secondary Report for the State of Montana

Cardno ENTRIX
Shaping the Future

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http://commerce.mt.gov/energy/default.mcpx

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Acronyms

BBER ..... Bureau of Business and Economic Research
BNSF ..... Burlington Northern Santa Fe Railroad
BPA ..... Bonneville Power Administration
CHP ..... Combined Heat and Power
DOE ..... Department of Energy
EIS ..... Environmental Impact Statement
FTE ..... full time equivalent
GLI ..... Global Labor Institute
GWh ..... Gigawatt hour
IMPLAN ..... impact planning and analysis
JEDI ..... Jobs, Economic Development and Impacts
Kw ..... kilowatt
KXL ..... Keystone XL Pipeline
MATL ..... Montana-Alberta Tie-Line
MDOC ..... Montana Department of Commerce

MPC	Montana Power Company
MSTI	Montana States Transmission Intertie
MW	megawatts
MWh	Megawatt hour
NREL	National Renewable Energy Laboratory
NWE	NorthWestern Energy
PB	Parsons Brinkerhoff
REMI	regional economic modeling and impacts
S&PF	State and Private Forestry
USACE	US. Army Corps of Engineers
WAPA	Western Area Power Administration

Executive Summary

Economic impacts of energy development are often quantified in feasibility studies, compliance documents, or other evaluations to inform business, political, environmental, and social decisions. This report compiles and evaluates various economic feasibility and impact reports for multiple types of energy production in the state of Montana. Through evaluating these reports it became apparent that there are a limited number of studies publicly available that are specific to the state of Montana energy projects. Furthermore, there seems to be few publicly available studies that use economic modeling such as impact planning and analysis (IMPLAN) or regional economic modeling and impacts (REMI). However, we have compiled the studies to the extent that they could be found, recently have been completed, and are publicly available.

This report consists of findings from a comprehensive literature review of existing economic analyses as well as personal interviews with industry experts concerning the economic impacts of energy developments in the state. The purpose of this report is to inform and provide additional economic information for energy developers and others interested in energy development.

This report has been prepared as a college intern project made possible by funding through Governor Brian Schweitzer's Office of Community Services' Energy Intern Program. Oversight of the project was provided by Cardno ENTRIX, along with assistance provided by the Energy Promotion and Development Division of the Montana Department of Commerce (MDOC). The information provided in this report was supplied from several organizations, academic institutions, energy developers, and other entities involved in the energy sector of the economy. Through these sources we believe the compilation of information provides an overview of the potential economic impacts energy development can have on the state of Montana. Analyses of both existing and proposed projects are included below.

Beginning with Montana's vast conventional/traditional energy resources we compiled studies evaluating the economic impacts of coal mining, coal fired power generation, oil and gas development, and the transportation of these resources via pipelines and rail. This report then presents the existing and future economic impacts of renewable energy resource developments, such as hydroelectric, wind, solar, and biomass. The report also examines the economic impacts of the construction of transmission lines to deliver electricity to export markets.

Coal, oil, and gas resources are the main contributors of energy development in Montana and have provided the greatest economic benefits to the state. However, renewable energy projects, a relatively new sector, are increasingly being developed and are having very positive impacts on the State's economy. This comprehensive report indicates that the potential for energy driven economic development is great and that by continuing to develop both traditional and renewable energy sources. Montana's economy can continue to thrive and grow. The studies analyzed in this report represent over $10 billion in existing and potential capital investment and 60,000 high paying construction and permanent jobs, generating millions of dollars in revenue for state and local government.

The results of studies compiled in this report indicate that Montana is gifted with a broad portfolio of energy resources that can be developed, providing the state with comparative advantages and economic opportunities that few other states can match.

1 Introduction

1.1 Background of Energy Production

Because of Montana's abundant resources, the state is a net exporter of energy. With over 40 electrical generating facilities in Montana, electrical suppliers are able to provide energy to states all over the Northwest. The largest facilities are the four privately-owned coal-fired plants at Colstrip, which have a combined generation capability of 2,094 MW. The largest hydroelectric plant in Montana is the U.S. Army Corps of Engineers' (USACE) Libby Dam with a capability of 598 MW.[1]

PPL Montana's facilities, the largest generating company in the state, produced almost 30 percent of the total electricity generated in Montana in the 2003 to 2007 period. Puget Power was the second largest producer with 17.1 percent. Federal agencies–the Bonneville Power Administration (BPA) and Western Area Power Administration (WAPA)–collectively generated 15.5 percent of the electricity in Montana.[2]

There are 31 distribution utilities that serve Montanans, consisting of two investor-owned utilities, 25 rural electric cooperatives, 3 federal agencies, and one municipality. In 2007, investor-owned utilities were responsible for 43 percent of electricity sales in Montana, co-ops were responsible for 25 percent, federal agencies three percent and power marketers 29 percent.[3]

Table 1-1 Ten Largest Plants by Generation Capacity, 2009

Plant	Primary Energy Source or Technology	Operating Company	Net Summer Capacity (MW)
1. Colstrip	Coal	PPL Montana LLC	2,094
2. Libby	Hydroelectric	USACE-North Pacific Division	599
3. Noxon Rapids	Hydroelectric	Avista Corp.	548
4. Hungry Horse	Hydroelectric	US Bureau of Reclamation	419
5. Yellowtail	Hydroelectric	US Bureau of Reclamation	287
6. Kerr	Hydroelectric	PPL Montana LLC	193
7. Fort Peck	Hydroelectric	USACE- Missouri River	180
8. J. E. Corette Plant	Coal	PPL Montana LLC	154
9. Hardin Generator Project	Coal	Rocky Mountain Power	109
10. Thompson Falls	Water	PPL Montana LLC	95

1 Blend Jeff, et al. 2009-2010, A Guide to Electricity, Natural Gas, Coal, and Petroleum Produced and Consumed in Montana, Department of Environmental Quality and Energy and Telecommunications Interim Committee Staff, http://leg.mt.gov/content/publications/committees/interim/2009_2010/2009understanding-energy.pdf.

2 Ibid.

3 Ibid.

Table 1-2 Average Generation by Company, 2003 – 2007

Company	MW	Percent
PPL Montana[1, 2]	947	29.2%
Puget Sound Power & Light[2]	573	17.7
Avista[2]	347	11.5
Bonneville Power Administration[3]	343	10.6
Portland General Electric[2]	251	7.7
NorthWestern Energy[2, 4]	189	5.8
Western Area Power Administration[3]	159	4.9
PacifiCorp[2]	129	4.0
Rocky Mountain	83	2.6
Invenergy	50	1.6
Yellowstone	48	1.5
Other	97	3.0
Total	3,243	100.0%

1 PPL Montana Plants were owned by Montana Power Company until mid-December 1999

2 Public data on output for Colstrip 1-4 is reported for entire facility, not individual units. In this table, the output was allocated among the partners on the basis of ownership percentages. NorthWestern Energy actually leases its portion of Colstrip.

3 Distributes power generated at US Corps of Engineers and US Bureau of Reclamation dams.

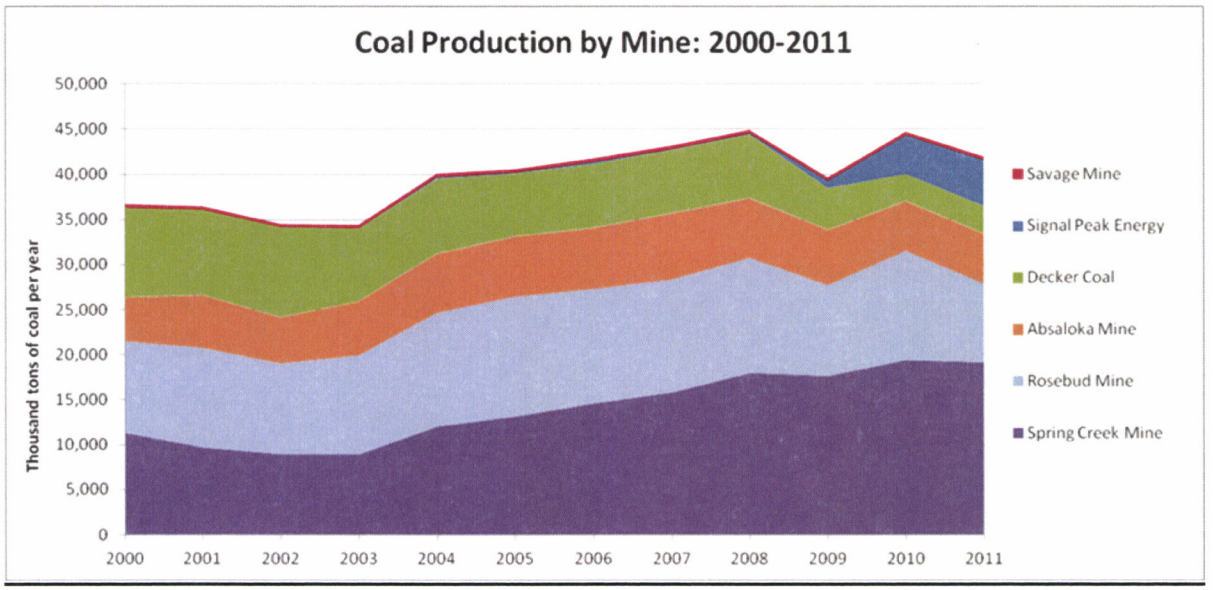
4 MPC sold its plant, contracts, and leases to NWE in February 2002.

1.2 Resources Available

Montana has abundant supplies of coal, oil, natural gas, and wind, and plentiful resources of hydropower and biomass. Montana is ranked first in potential coal reserve base, and number five in coal production of the fifty states.[4] These reserves are found mostly in eastern Montana, stretching to the north and south. Oil and natural gas have recently been revitalized with the Bakken oil field, which is situated mostly in the north and east of Montana, with possible reserves stretching down towards the northwest corner of Wyoming. Recent studies of wind availability have found that Montana has an abundance of wind power potential in the east and north, as well as along the Rocky Mountain front. Rivers located throughout the state offer potential un-tapped energy resources (in particular existing hydropower dams where electricity generation can be increased cost effectively), similar to biomass, where forests covering the western part of the state can provide the feedstock to potentially produce large amounts of energy.

Montana currently has six operating coal mines located throughout the state. Below, the chart shows the production of each operating mine since 2000. The Spring Creek Mine located near Decker and operated by Cloud Peak Energy is presently the largest producer in Montana at about 19,000 million tons per year.

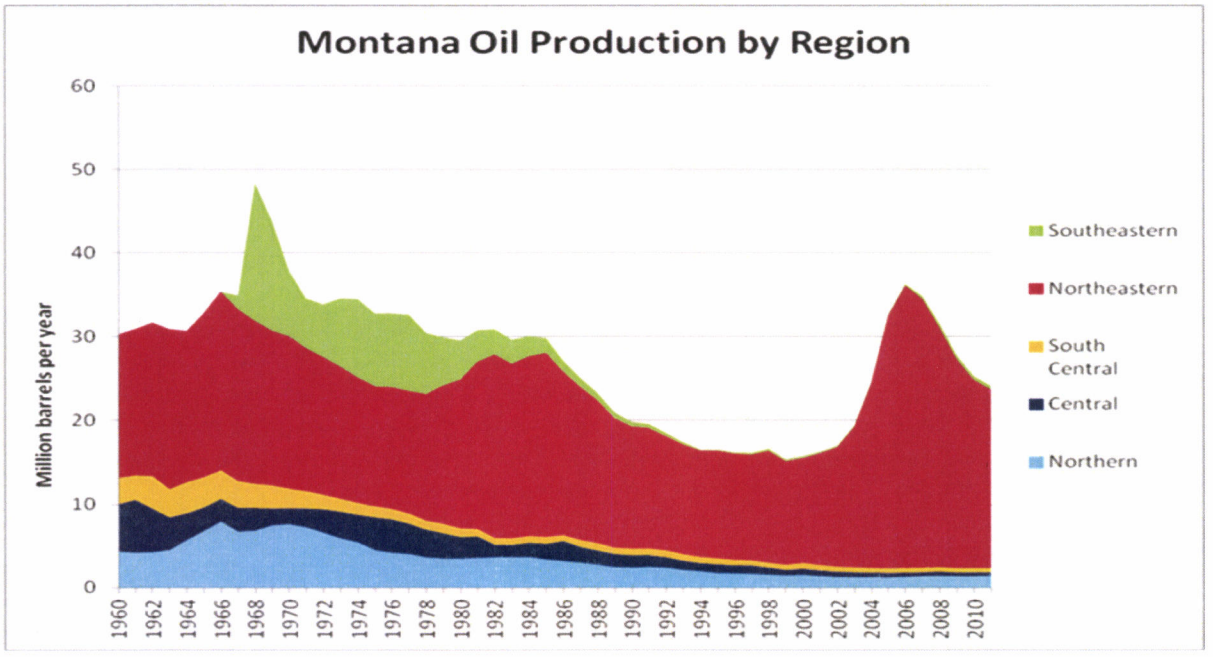
4 Montana Coal Council, http://montanacoalcouncil.com/facts_figures.html, accessed July 2012.



Source: U.S. Energy Information Administration

Figure 1-1 Coal Production by Mine: 2000-2011

Shown in the chart below the largest share of oil production in Montana occurs in the southeastern and northeastern areas of the state. In recent years with development of the Bakken oil play and the use of hydraulic fracturing, eastern Montana is producing significant amounts of oil.



Source: U.S. Energy Information Administration

Figure 1-2 Montana Oil Production by Region

Montana has greater wind potential than any other western state, with a total potential of generating 830,504 GWh/yr.

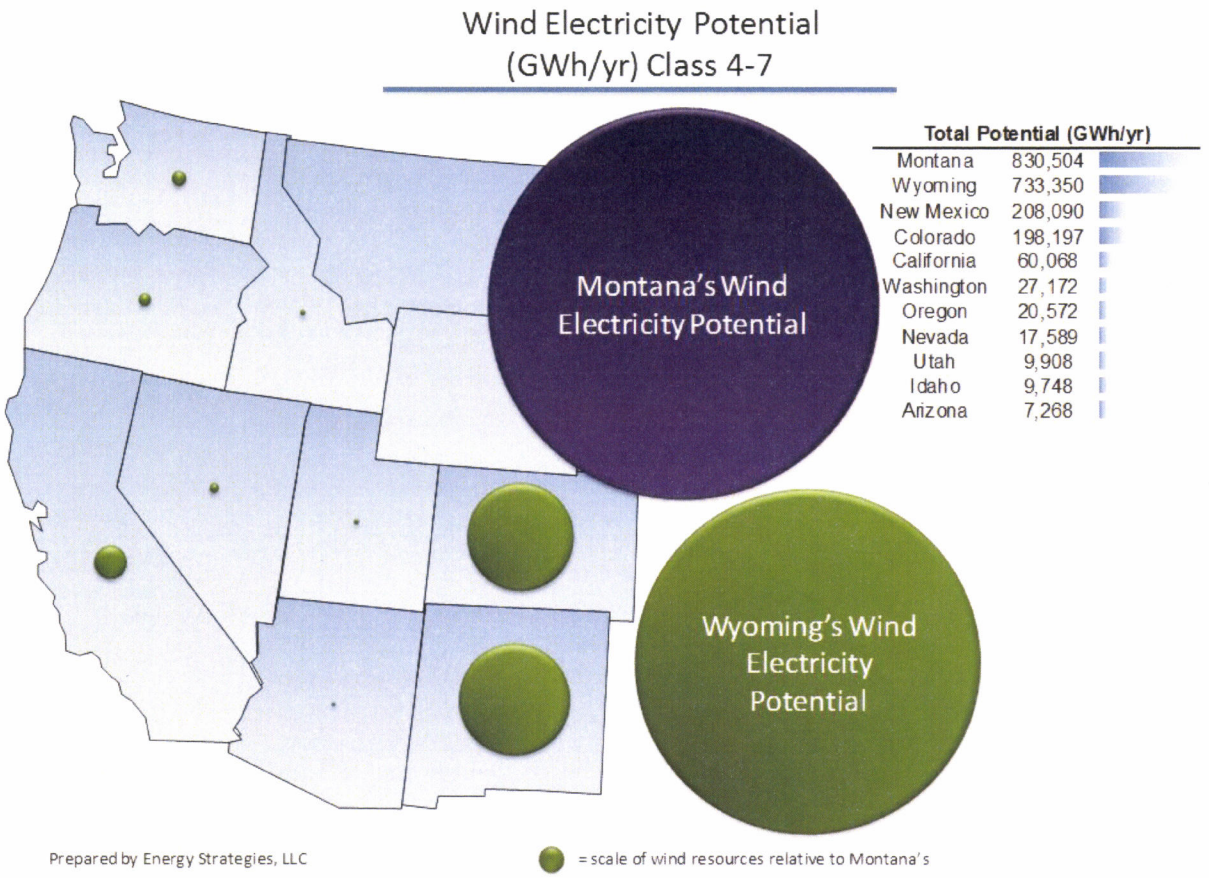


Figure 1-3 Wind Electricity Potential

1.3 Economic Impacts

There are two general stages of economic impacts that result from energy production. The first is through construction, the second is operation. During construction, there is an influx of jobs, money, and economic activity as construction of the mine, oil rig, wind turbines, or other relevant facility is established. When operations start, these construction jobs are replaced by long-term operating and maintenance jobs. As shown by history, this can have a significant impact upon the local economy. These impacts are especially felt in small towns where employment might be scarce; energy production can provide several hundred jobs in the short and long term for local residents, often attracting workers that spend money on products and services in the region.

1.4 Measurement of Economic Impacts

Input-output analyses are mathematical representations of an economy, detailing the transactions between business-to-business and business-to-final end users. The resulting mathematical formula represents a detailed model of different transactions between sectors in the region. The model is broken down into three main components: the demand table, final demand table, and the value added table. The demand table includes sales between industries for intermediate use only, not sales to end-users, while final demand includes sales to consumption, investments, government, and exports. The value added

table consists of labor, profits, and imports. Since it is an accounting model, inputs must equal the outputs. The model seeks to understand how changes in demand and final goods can affect the economy as a whole. By using models, researchers are able to analyze how industries are linked to one another, how they can impact the economy of a region, and the ripple effect throughout the economy.

1.5 Why We Use Economic Analysis

Economic analysis is vital to understanding the potential impacts regarding economic impacts of energy production in the state of Montana. Economic impacts are the basis of many other political, social, and environmental decisions that affect the entire state. Because of this, it is vital that these studies be as precise as possible and be reported in a way that is understandable.

2 Impacts by Development

2.1 Conventional/Traditional Energy

2.1.1 Coal Mining & Distribution

In 2012, the Bureau of Business and Economic Research (BBER) estimated the economic impact to the state of Montana of operating the proposed Otter Creek coal mine over the course of 20 years. BBER estimates the Otter Creek mine would create a total of $103.5 million of new personal income during construction ($87.7 million in after-tax income) and $23.5 million in state and local tax revenues. Mine operation would generate $125.4 million in new personal income and $91.6 million per year in state and local tax revenues. During the construction phase, 2,648 jobs would be created, lasting two years. Additionally, 1,740 long-term jobs would be created during the operations phase.[5]

Table 2-1 Impacts Summary: Otter Creek Mine

	Impacts by Phase	
Category	Construction	Operations
Total Employment	2,648 Jobs	1,740 Jobs
Private Sector Employment	2,372 Jobs	1,338 Jobs
Personal Income	$103.5 mill.	$125.4 mill.
Disposable Personal Income	$87.7 mill.	$167.9 mill.
Population Increase	1,025 people	2,843 people
State tax revenues ($ millions)	$23.5 mill.	$91.6 mill.

The Otter Creek mine involves a huge capital investment of over $1 billion in equipment, facilities, rail, and other infrastructure in the state that will positively impact Montana's economy. The table above represents the impacts of development, construction and operation of the mine totaling $599.6 million. BNSF engineers estimated construction cost of the Tongue River Railroad used to haul coal from the mine to be about $471 million. The jobs created by the railroad construction are incorporated in the total employment figures in the table above.

Spring Creek Mine

A recent economic analysis conducted by the University of Montana's Bureau of Business and Economic Research showed that increasing production at the Spring Creek Mine by 20 million tons per year would have substantial economic benefits to the state. The expansion under consideration would create 1,461 jobs, add $58.8 million in income received each year collectively by Montana households, a 579 person population increase with more to follow in future years, and $70.1 million per year in selected state government tax revenues. Most of the jobs created would be good-paying jobs well above the median wage in Montana.

[5] Bureau of Business and Economic Research, 2012, *The Impact of Otter Creek Coal Development on the Montana Economy*, University of Montana.

2.1.2 Coal Power Plants

Colstrip Plant Units 1-4

In 2010 Patrick M. Barkey, PhD, and Paul E. Polzin, PhD conducted a study on the economic contribution of Colstrip Steam Electric Stations Units 1-4 for the owners of the electric station. The study used the REMI model to assess the direct and indirect economic impacts of Colstrip on the Montana economy as a whole, but focusing on the region of eastern MT.

Table 2-2 The Economic Contribution of the Colstrip Steam Electric Station Units 1-4: Impact Summary

Category	Units	Impact	
		Montana	Eastern MT
Total Employment	Thousands(Jobs)	3.7	3.5
Private Non-Farm Employment	Thousands(Jobs)	2.7	2.5
Gross Domestic Product	Millions of Dollars	638.5	621.1
Personal Income	Millions of Dollars	362.1	340.2
Disposable Personal Income	Millions of Dollars	322.9	303.4
Population Increase	Thousands	7.8	7.3

Source: Patrick M. Barkey, Ph.D. and Paul E. Polzin, Ph.D, *The Economic Contribution of Colstrip Steam Electric Station Units 1-4*

The study shows that the operation of the Colstrip Electric Station along with the WECo coal mine produce a state economy, particularly in eastern Montana that is larger, more populous and more productive than it would be in the absence of the plant. Colstrip's generating facility operations are responsible for more than 7 percent of all jobs, 17 percent of all economic production, 9 percent of all income, and 13 percent of the school-aged population in the region.[6] The rest of the state benefit from the ripple effect that Colstrip has on the trade flow contributing to businesses and consumers. Colstrip also contributes to the Montana state economy by increasing state and local tax revenues that are spread throughout the state. The State collected more than $68 million in taxes and royalties directly or indirectly connected to Colstrip which represents 4.5 percent of the Montana Department of Revenue collections in 2008. The plant generates about $26.3 million in property taxes on pollution control and electric generation equipment.[7] According to the BBER report, given the $103.9 million in taxes paid to the state and nearly $640 million in economic output it is difficult to understate the economic impact that the Colstrip Generating Station has on the state of Montana.

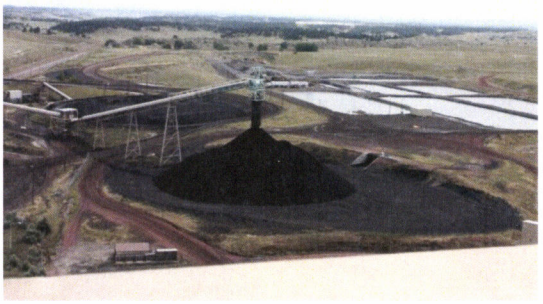


Image courtesy of www.mt.gov

[6] Patrick M. Barkey and Paul E. Polzin, 2010, *The Economic Contribution of Colstrip Steam Electric Station Units 1-4.*

[7] Ibid.

2.2 Oil and Natural Gas

Scott Rickard from the Center for Applied Economic Research in Billings estimated the economic impact of the entire oil and natural gas industry for the state of Montana during 2007. The report evaluated the covered exploration, development, production, refinement, and transportation of raw or finished materials, but not retail distribution. The total economic impact of the defined industry was over $9 billion, accounting for over 12,000 total jobs (direct and indirect), and over $450 million generated in tax revenue for state and county governments.

According to the study, nearly 100,000 barrels of oil were produced each day in 2007, making Montana the 10th largest producer of crude oil in the nation. Most of the production occurred in southeast Montana, with Richland and Fallon counties generating 80 percent of total oil produced. There were approximately six companies that produced the majority of the oil. Natural gas production is similar, where Fallon, Phillips, Richland, Hill, and Blaine counties represented over 70 percent of natural gas production. The estimated value of oil production in Montana during 2007 was $2.3 billion, while natural gas was valued at $744 million.

Montana's oil and natural gas production taxes totaled $186 million, with approximately $184 million from oil and $59.52 million from natural gas. Because companies involved with the oil and gas industry are also large property owners, over $90 million in property taxes can also be associated with the industry. Based upon a 5.8 percent income tax rate and the average income range found in the industry, workers paid an estimated $18.6 million in income taxes.

While the raw value of production was slightly over $2.4 billion, it was estimated that $5 billion worth of refinery output in the state of Montana was created from this production in 2007. The total value of the output was more than $9 billion, and the 4,500 jobs directly created by the industry supported more than 7,500 additional jobs elsewhere, for a total impact of over 12,000 jobs.[8]

In 2012, Montana total oil production is expected to be around 25 million barrels, and while this is down from the recent 36 million barrel peak of 2006, indications are that Montana production will continue to trend upward. The oil boom across the border in North Dakota has been in full swing with daily production in late 2012 topping 700,000 barrels per day (annual production will top 200 million barrels in 2012). The recent record setting paces of Montana oil leases being established on state owned land, increasing drilling rig counts (from 9 to 25 in one year), the announcement of large tracts of private land being leased in Montana along with a very favorable production tax regime in Montana provide indications that Montana oil production will increase and significantly.

2.2.1 Baker "on-ramp", Bakken Marketlink

In November 2011, Dr. Scott Rickard provided an analysis of the economic impact of the Baker on-ramp also known as the Bakken Marketlink. The "on-ramp" located near Baker, Montana will provide improved market access to Montana oil producers as well as increase the economic benefits the oil industry provides to the state. Dr. Rickard's analysis predicts that the Baker "on-ramp" has the potential to greatly benefit Montana in several areas of the oil industry which will result in economic growth for the state. The development of the "on-ramp" will increase oil exploration, drilling and production resulting in more jobs and tax revenue. The onetime initial impact is expected to create 348 jobs with $16 million in labor income and $118 million in sales, with an annual impact of 131 jobs, $6.8 million in labor income, and $33 million in sales.

[8] Rickard Scott, 2008, *Economic and Fiscal Impacts of Montana's Petroleum and Natural Gas Industries*, The Treasure State Journal, Center for Applied Economic Research, Montana State University, Billings.

Table 2.3 One Time Initial Impacts

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	103.6	$6,522,509	$27,718,198	$88,000,000
Indirect Effect	157.8	$7,201,398	$11,845,332	$21,360,884
Induced Effect	86.7	$2,709,762	$5,146,289	$8,573,107
Total	348.1	$16,433,670	$44,709,819	$117,933,991

Source: Dr. Scott Rickard, Additional Montana Oil Production Due to the Operation of the Bakken Marketlink, November 13th, 2011.

Table 2-4 Annual Economic Impacts

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	58.3	$3,980,591	$10,529,734	$23,000,000
Indirect Effect	35.0	$1,681,480	$3,115,162	$5,818,960
Induced Effect	37.6	$1,166,831	$2,222,159	$3,695,824
Total Effect	130.9	$6,828,902	$15,867,056	$32,514,784

Source: Dr. Scott Rickard, Additional Montana Oil Production Due to the Operation of the Bakken Marketlink, November 13th, 2011.

The analyses by Dr. Rickard, shown above, are useful to help us understand the economic impacts that oil and gas have on the state. However, the oil and gas industry is in a constant state of transformation, development and change. As noted previously, oil and gas production in the state has decreased since its recent 2006 peak, but growth of the Bakken production in North Dakota and anticipated Montana production growth will continue to benefit the economies of the communities in northeastern Montana. After a decline in production of crude oil over the past five years, well permits are beginning to increase, more land on the Montana side of the oil play is being leased and production is expected to once again increase. Oil and gas companies are beginning to show new interest in the western portion of the Bakken. One such company, Donco, a parent company of Shale Exploration announced in October 2012 its plans to lease over 200,000 acres in the northeast Montana counties of McCone and Garfield. The Keystone XL (KXL) pipeline's southern portion is under construction and the reapplication to the federal government for the northern section, including the section to be built in Montana, is under review and could be approved as early as the first quarter of 2013 with construction to commence in the second quarter. Between the construction of the pipeline and the improved market access for Montana oil producers, the state's economy is sure to prosper even more. Community development plans to accommodate the population increase are in progress and are seeking to address housing and infrastructure needs in rural eastern Montana. The Bakken formation is expected to produce crude oil for at least 25 more years, which will result in long-term growth to the Montana economy.

2.3 Pipelines

The potential economic impacts of the KXL pipeline have been heavily debated. Reports and analyses of the impacts associated with the proposed pipeline have been published by The Perryman Group,[9] Global Labor Institute (GLI),[10] Energy and Water Economics, [11] and addressed in the Department of State's environmental impact statement (EIS) (Cardno ENTRIX).[12]

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[9] The Perryman Group, June 2010, *The Impact of Developing the Keystone XL Pipeline Project on Business Activity in the US*, Waco, Texas.

[10] Global Labor Institute, September 2011, *Pipe Dreams? Jobs Gained, Jobs Lost by the Construction of Keystone XL*, Cornell University.

According to the third party EIS prepared by Cardno ENTRIX, the construction phase of KXL Pipeline would consist of approximately 5,000 to 6,000 workers, including Keystone employees, contractor employees, and construction and environmental inspection staff. The construction phase is expected to generate $349 to $419 million in total wages. An estimated $6.58 to $6.65 billion would be spent on materials and supplies, easements, engineering, permitting and other costs. These estimates address only the construction phase. It is likely that additional jobs may be created in the operation phase but it is unclear if these jobs will represent additional jobs or displacement of existing jobs elsewhere. Other analyses attempted to include all jobs and impacts associated with the pipeline instead of just during the construction phase. The table below presents the assumptions used in the economic analyses mentioned above.

Table 2-5 Potential Economic Impacts of the Keystone XL Pipeline

	Units	Perryman Group	Perryman Group	GLI	EIS (Cardno)
Total Employment	Thousands	59.468	36.860	16.149	Up to 6.0
Non Labor Direct Impacts	2011 $ (billions)	$20.93	$9.22	$6.01	$6.60
Personal Income per Job	Annual $	$54,651	$43,327	$42,047	$34,940

2.4 Renewable Energy

Wind farm development has progressed significantly in Montana, from only 1 MW of total installed generating capacity in 2005 to nearly 650 MW by the end of 2012. And with these developments come the economic benefits, as described below.

2.4.1 Wind

The Center for Rural Affairs released a study summarizing the U. S. Department of Energy's (DOE) findings about the economic impacts of increasing Montana's wind generating capacity to 5,261 megawatts by 2030. They found that there would be 8,973 new direct jobs within the first two years from construction, and an additional 1,424 new jobs created over the next 20 years from operation and maintenance. Through indirect and induced impacts, 7,915 new jobs would be created within those first two years, and 1,451 new jobs over the next 20 years.

The total impact would be 16,888 new jobs during the two-year construction period and an additional 2,875 new jobs in the 20-year operations period. They also found that $14 million of annual lease payments (direct impacts) would be paid to landowners, and $78.2 million in local property tax revenue would be generated annually. In general, the direct impacts that would benefit the local economy would be $992 million within the two-year construction period and $111.7 million over the 20-year operations period. Indirect and induced impacts to the local economy would total $621 million within the first two years and $119 million in the next 20 years.

[11] Wade William *et al*, February 2012, *The Keystone XL Pipeline: REMI Estimates of Economic Impacts from Construction and Operations based on the Keystone Record*, Energy & Water Economics, Washington DC.

[12] Final Environmental Impact Statement, Keystone XL Project, United States Department of State Bureau of Oceans and International Environmental and Scientific Affairs, Volume 1, August 26, 2011.

Additionally, it is worth noting that if wind energy were developed to supply 20 percent of the nation's electricity, four trillion gallons of water would be conserved, an important issue in the western states. Finally, Montana has the fifth greatest potential for wind resources in the United States, showing immense potential for further development of wind resources. [13]

The National Renewable Energy Laboratory (NREL) released a study in 2004 that comprehensively evaluated the economic effect of different wind project sizes on six different Montana counties: Blaine, Cascade, Glacier, McCone, Park, and Prairie. The wind project sizes were 5, 10, 20, 50, 100, and 300 megawatts respectively, and it was assumed the turbines were 1.5 MW each, which was the average size at that time. The Jobs, Economic Development and Impacts (JEDI) model they used was derived from the IMPLAN model. The author assumed costs would be $1,000 per kilowatt (those costs were closer to $1,500/Kw in 2012), because most costs are proprietary and difficult to uncover, similar to the assumption that annual maintenance and operations costs would be $12.50 per kilowatt. [14]

Table 2-6 Annual Jobs per Project Size, Location, and Ownership[1]

County, Local Ownership %	Project Size (MW)					
	5.0	10.0	20.0	50.0	100.0	300.0
Blaine						
0%	1.6	3.1	6.3	15.6	31.2	93.5
50%	2.3	4.5	8.9	22.3	44.4	133.2
100%	2.9	5.8	11.6	28.9	57.7	172.9
Cascade						
0%	2.8	5.4	10.9	27.1	54.2	162.4
50%	4.0	7.9	15.7	39.2	78.2	234.6
100%	5.2	10.3	20.5	51.2	102.3	306.8
Glacier						
0%	2.1	4.1	8.1	20.3	40.4	121.1
50%	2.8	5.5	11.1	27.6	55.2	165.4
100%	3.6	7.0	14.0	35.0	69.9	209.7
McCone						
0%	1.3	2.5	5.0	12.5	24.8	74.4
50%	2.1	4.1	8.2	20.3	40.6	121.7
100%	2.9	5.7	11.3	28.2	56.4	169.0
Park						

[13] Center for Rural Affairs, October 2009, *20% Wind by 2030*, Lyons, Nebraska.

[14] Costanti Michael, 2004, *Quantifying the Economic Development Impacts of Wind Power in Six Rural Montana Counties Using NREL's JEDI Model*, NREL, Golden, Colorado.

County, Local Ownership %	Project Size (MW)					
	5.0	10.0	20.0	50.0	100.0	300.0
0%	1.9	3.7	7.4	18.4	36.7	110.2
50%	2.9	5.8	11.6	28.9	57.7	173.1
100%	4.0	7.9	15.8	39.4	78.7	236.1
Prairie						
0%	1.3	2.5	4.9	12.2	24.3	72.8
50%	2.6	5.1	10.3	25.6	51.1	153.3
100%	4.0	7.8	15.6	39.0	77.9	233.7

1/ Jobs are FTEs

Source: Center for Rural Affairs

2.4.2 Proposed Wind farms to be Located on State Owned Lands

Three proposed wind farms are currently being developed on state- owned lands, including the 80-MW Coyote Wind Farm, the 57-MW Martinsdale Wind Farm and the 480-MW Jawbone Wind Farm. The state has completed EISs for the Coyote and Martinsdale Wind Farms. While the EIS for the Jawbone Wind Farm is being prepared and has not been released, but it is estimated the project could cost over $750 million to construct and would create nearly 500 construction jobs and 50 permanent jobs. Below are estimated socio-economic impacts for two of the three proposed wind farms:

Martinsdale Wind farm

A subsidiary of Horizon Wind Energy, this proposed 59-MW to 300-MW wind energy facility will be located in central Montana approximately 20 miles west of Harlowton. The development of this project would create 278 jobs during construction and 18 permanent operational jobs. The total estimated cost of the Martinsdale project is about $280 million, representing a significant economic development in the area.

Coyote Wind farm

The 80-MW Coyote wind farm is being developed by Spanish wind developer Elecnor Energy, will be located between Big Timber and Livingston, Montana, would create jobs in the area and generate revenue for the local and state economies. The project would be in operation 24 hours per day, 365 days per year unless off-line for scheduled or unscheduled maintenance. There would be an average of 400 workers on-site during construction and when completed the project would create 4 permanent jobs.

Montana-Alberta Tie-Line (MATL) Associated Wind farms

The MATL power transmission project is a 214 mile 230-kV line allowing the movement of power between Montana and Alberta, Canada. It will create 600 MW of new capacity that has been targeted for wind energy development in Montana.

MATL will create an additional connection with energy markets (e.g., load centers) and additional wholesale electricity purchasing options for Montana utilities. This could result in lower electricity rates for Montanans due an increase in supplier competition. Because MATL would be able to connect with adjacent electric systems, different generation resources would be able to combine to provide an increased level of reliability.

Table 2-7 Summary of Estimated Economic Effects of Different Levels of Wind Generation in the Study Area

Amount of Wind Generation	Construction Jobs (Short Term)	Permanent Jobs over Lifetime of Wind Farms	Construction Earnings to Montana Workers	Annual Earnings from Wind Farm Operation	Annual County Revenue ($ Millions)	Payments to Local Land-Owners ($ Millions)
300 MW	530	25-30	$20,000,000	$2,300,000	2.3 to 3.0	1.0
600 MW	1,060	50-60	$40,000,000	$4,500,000	5.5 to 6.0	2.0
800 MW	1,400	Up to 80	$53,000,000	$6,000,000	Up to 8.0	2.7
1,300 MW	2,300	Up to 130	$87,000,000	$9,750,000	Up to 13.0	4.4

Note: 1,300 MW would impose larger costs on the local area in terms of demand for services, change in the character of the area, and change in land use.

Source: MATL FEIS United States Department of Energy and State of Montana Department of Environmental Quality.

NaturEner USA, developer of the Glacier and Rim Rock wind farms which are the largest in Montana located in Glacier and Toole Counties, with a combined total of 399 MW of generating capacity installed, estimates that when the full 510-MW for these two giant wind farms are built, they will generate about $17.1 million annually in local property taxes and landowner royalties over 25 years of operation. Given that about 80 percent of that total 510-MW of generating capacity is installed, most of those estimated economic benefits are now flowing into the state as anticipated. The remaining undeveloped portion of the Rim Rock Wind farm, consisting of 121 MW of capacity, is a "shovel ready" project, with transmission capacity, that will be ready to develop as soon as market conditions are favorable.

2.5 Solar

There are currently no existing studies about the economic impacts of large solar energy projects in Montana. After talking to experts in this field, we found it is generally not considered economically feasible to develop large solar farms with the current technology and the amount of sunlight exposure available across the state.

2.6 Biomass

2.6.1 Montana Woody Biomass Combined Heat and Power Project

Regional Foresters in the Northern and Intermountain Regions State and Private Forestry (S&PF) reported on the impacts of F.H. Stoltze Land and Lumber 2.5 MW combined heat and power (CHP) project in Columbia Falls, Montana. The company will sell up to 2.5 MW to Flathead Electric Cooperative for 9 cents per kilowatt-hour. To date they have received $200,720 in federal funds for the $20 million project.

Photo source: Lido Vizzutti/Flathead Beacon

The project will create 3 to 6 new boiler operations and maintenance jobs at the mill and another 3 to 6 new in-wood fuel production jobs, affecting a 75-mile radius of the mill, that encompasses most of Flathead, Lincoln, and Lake counties. The project is expected to add $7.5 million in wages for suppliers and contractors to the

local economy over two years. Equally as important, it will also diversify F.H. Stoltze's income and help retain over 100 jobs at the mill, while stabilizing about 65 forest management jobs.[15]

2.6.2 Biomass Energy Feasibility Studies

In 2010, the MDOC funded two Montana biomass feasibility studies. One of those studies was prepared by NorthWestern Energy and other was prepared by the PBE consulting team. NorthWestern Energy hired the Montana Community Development Corporation to explore the feasibility of developing woody biomass-fueled CHP plants at sawmills in western Montana, in order to supply a portion of NorthWestern Energy's required renewable energy portfolio. The study used an IMPLAN model to evaluate the employment and labor income impacts of construction and operation of a prototypical biomass energy plant in Montana. The prototypical plant would generate 18 MW and have a 150,000-pound per hour boiler. Such a plant would require about 121,000 bone dry tons of fuel annually.

During the construction phase the total capital costs for the prototypical plant were estimated to be $53.6 million. The total construction expenditures would include nearly $15 million in labor costs, of which an estimated $7.3 million would be paid to 73 full-time on-site construction workers in Montana, and an estimated $31 million used for construction materials. Based upon the structure of the Montana economy and the types of construction materials required, it was estimated that this expenditure would generate additional output in Montana of approximately $8 million in sectors such as wholesale trade, truck transportation, and manufacturing. Engineering, permitting and project management costs were assumed to be spent in Montana and estimated to be $800,000. Banking activity was assumed to be spent outside of Montana, and is estimated to be $5 million over the course of construction.

Table 2-8 Direct Spending in Montana Associated with a Prototypical CHP Plant

Spending Category	Spending Amount (Dollars)
Total Labor	7,277,000
Total Construction Materials	7,970,000
Engineering	800,000
Banking Activity	0
Total Spending in Montana	16,047,000

Total construction impacts were estimated to be approximately 216 jobs in the state of Montana and a corresponding $12.4 million in employee compensation for the one-year construction period. Of this amount, 73 jobs and $7.3 million were related to direct construction. It was further estimated that 76 jobs and close to $3 million in income would result from increased economic activity in indirectly-linked sectors providing construction inputs, support services, or additional output, such as trade, transport, manufacturing, or others. Induced impacts, or increases in household spending resulting from the project, were valued at $2.08 million and 67 jobs. The total economic income impacts related to construction would account for $86 per MWh for the first year of power production.

Table 2-9 Total Impacts in Montana for Construction of a Prototypical Plant

	Direct	Indirect	Induced	Total
Jobs	73	76	67	216
Income (Dollars)	7,277,000	2,989,000	2,085,000	12,351,000

[15] Intermountain and Northern Regions State & Private Forestry, May 22, 2012, R1/R4 State and Private Forestry Biomass Activities.

The total economic impacts from operation of the plant were estimated to be 43 jobs and $2.3 million in employee compensation. Thirteen of the jobs and $1.15 million would be for biomass plant employees. Indirect impacts of 17 jobs and $800,000 were estimated as part of the increased spending on plant inputs and support services for the plant operations. Induced impacts of nearly 13 jobs and $397,800 would be supported by increased household spending associated with the increased economic activity from operation of the plant. The total economic impacts related to operating the CHP plant would be equivalent to $16 per MWh on an annual basis.[16]

Table 2-10 Total Impacts in Montana from Operations of a Prototypical CHP Plant

	Direct	Indirect	Induced	Total
Income (Dollars)	1,150,000	802,000	397,800	2,350,000
Jobs	13	17	13	43

2.6.3 PBE Feasibility Study

The PBE Biomass Feasibility Study was completed in 2010 by a team of technical experts headed up by Parsons Brinkerhoff (PB) Americas in western Montana with the purpose of assessing the feasibility of constructing a woody biomass plant. The analysis included the following key elements of woody biomass energy development: the assessment of biomass fuel supply in western Montana, description of a typical biomass facility, description of regulatory and permitting considerations, identification of one or more potential plant sites, assessment of financial feasibility, and preparation of a comprehensive document for use by the MDOC in considering woody biomass development. The project assessed several potential sites and selected the former Bonner Mill site as the best location to site a 60-MW plant. The estimated capital cost was about $178 million and annual operating cost was $7.5 million, primarily within the local economy. An estimated 500 construction jobs would be created, averaging 60 to 80 people with a peak participation of about 150. The report further estimated about 45 to 55 on-site daily operations jobs and about 400 jobs to supply the biomass fuel to the plant.

2.7 Transmission Lines

The Montana Department of Labor and Industry conducted a study titled "Employment and Economic Impacts of Transmission Line Construction in Montana". The study focused on the six major electric transmission line projects planned or under construction that would allow additional generation capacity in Montana and estimated the economic impacts of the constructing these lines. The projects included the 300 MW MATL, the 3,000-MW TransCanada Chinook Line from Montana to Las Vegas, the 1,500-MW (north to south) Mountain States Transmission Intertie (MSTI) from Montana to Idaho, the NorthWestern Energy Feeder Interconnect Lines to link power sources within state, the Grasslands Renewable Energy Feeder System, and the 700 MW upgrade to the existing 500 kV Colstrip line. If all of these projects were constructed as planned, they could add approximately 6,400 MW of transmission capacity to Montana's energy system.

The estimated employment impacts resulting from the construction of transmission lines were developed through an input-output analysis using IMPLAN software and 2008 industry data. The research

[16] Fitzpatrick John, et al. June 1, 2010, Sustainable Biomass Generation: A Regional Model for Western Montana, NorthWestern Energy and Montana Community Development Corporation.

estimated that transmission projects utilizing an out-of-state contracting firm would result in approximately 1.20 direct jobs per million dollars of capital expenditure, and an additional 0.75 jobs from related businesses and the spending of worker's wages.

Table 2-11 Job Creation and Economic Impacts of Transmission Lines in Montana

	Direct Jobs per Million Capital Expenditure	Induced and Indirect Jobs per Million Capital Expenditure	Total Jobs per million Capital Expenditure	Total Economic Impact per Dollar of Capital Expenditure
Out-of-state Contracting Firm	1.20	0.75	1.95	$0.19
In-state Contracting Firm	2.45	2.25	4.70	$0.59

The figures in the above table are derived from calculating the impact of each planned construction line separately, then averaging the results to generate the general results.

For most of the transmission projects considered in the research, it is likely that an out-of-state contracting firm would be utilized, due to the fact that higher-capacity transmission lines require highly-specialized workers and the ability to directly contract with manufacturers to supply inputs. Additionally, these projects could be too large for the average Montana contractor, who may not have the staff, resources, or experience to handle large transmission projects. The economic impacts estimates for the MSTI, Chinook, and Grasslands projects reflect this assumption, while the MATL line and the Northwestern Energy collector lines and upgrades assumed that in-state contractor firms would be used. The research adopted a 'production function' approach to estimating the economic impact to Montana, meaning the total amount of money spent on the project was divided into different industries that experienced increases in the final demand. The estimates are presented as if the spending and economic impacts were spread evenly over the timeframe of the projects.

Table 2-12 Economic Impact Estimates for Montana Transmission Projects

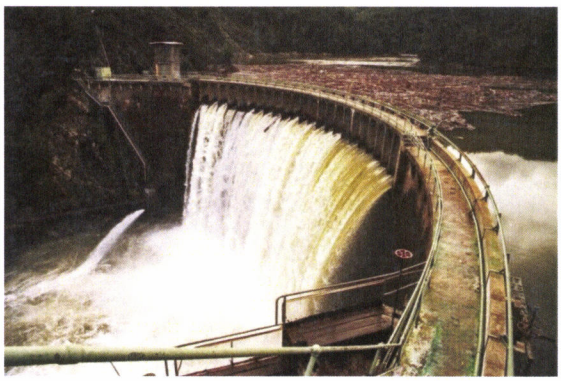
Project	2007 Real Dollar of MT Capital Expenditure	Instate/ Out-of-State	Direct Jobs	Direct Jobs per Year	Total Jobs	Total Jobs per Year	Direct Impact (2010 Dollars)	Total Impact (2010 Dollars)
MSTI	$616,431,000	Out	742	186	1,203	301	68,865,272	120.046,544
MATL	$162,132,000	In	360	180	720	360	52,492,984	92,173,816
NWE Collectors	$842,455,000	In	2,082	416	3,980	796	272,759,520	482,279,520
TransCanada Chinook Line	$939,502,000	Out	1,131	283	1,833	458	104,947,160	182,945,424
Grasslands	$1,474,639,000	Out	1,776	592	2,878	959	164,735,952	287,169,472
NW Upgrades (Colstrip)	$215,751,000	In	546	273	1,034	517	86,951,160	140,643,872

The table above summarizes the economic impact of transmission lines in Montana in 2010 dollars. The direct impact spending column represents the initial impacts of each project on the industries involved in constructing and repairing the transmission line, and direct spending by out-of-state workers. The total input column represents the total economic impact of each project on the Montana economy. This

includes the direct impacts on the businesses involved in each transmission project, the indirect impacts on suppliers, and increases in household spending.[17]

2.8 Hydropower and Others

Hydropower is currently the dominant renewable energy resource in Montana, generating 9,415 thousand megawatt-hours of net electricity in 2010[18]. It is the largest share of renewable energy in Montana, making up 31.6 percent of total electricity generation[19]. Recent hydropower development has continued to make it a reliable source of energy within the state.



2.8.1 Turnbull Hydro Generation Project

Turnbull Hydro, LLC completed their hydroelectric plant in 2011 which generates 13 MW of electricity from irrigation canals in the Greenfield Irrigation District without affecting the farmers' ability to access the water. This project will produce enough electricity to power 8,000 to 10,000 homes, with most of it used within the immediate vicinity. The capital investment in the project was approximately $10 million and created 30 construction jobs and two permanent jobs for operating the hydro facility.

Gibson Dam Project

The Gibson Dam on the Sun River is located on the Rocky Mountain Front near Augusta. It was originally built in the 1920's and was designed to include electric generating turbines, but they were never installed. Toll House of Bellingham, Washington is conducting this $25 million project to install the turbines capable of producing 15 MW of electricity.

Rainbow Dam Hydropower Project

The Rainbow Dam Hydropower Project was completed in September of 2012. PPL Montana invested $230 million in this project to raise the existing Missouri dam located near Great Falls 1.5 feet and replace eight turbines that generated 37 MW with one updated turbine capable of producing 62 MW. This project provided more renewable energy, improved the passage for fish, and created hundreds of local construction jobs over the 30-month construction phase that provided a boost to the state's economy.

Geothermal Energy Generation

Montana has more than 50 geothermal sites throughout the state and at least 15 of them are high-temperature with the capability to produce clean, renewable, and reliable heat and energy. Montana has the potential to develop significant new sources of geothermal energy that would benefit the state and create jobs. One geothermal project under development in the state is exploration for electric power generation in Warm Springs, Montana by the Dewhurst Group, LLC. The capital invested in the project to date has exceeded $10 million. Unfortunately, we were unable to find any recent economic studies about the feasibility of geothermal projects in Montana, but development is occurring in the state.

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[17] Wagner Barbara, July 30, 2010, Employment and Economic Impacts of Transmission Line Construction in Montana, Montana Department of Labor and Industry, www.ourfactsyourfuture.org.

[18] US Energy Information Agency, http://www.eia.gov/renewable/state/montana/, accessed July 2012.

[19] Ibid.

Table 2-13 Compilation of Energy Development: Economic Impacts Identified in this Report (Optimal)

Energy Sectors (Project Specific)	Capital Investment	Direct Jobs Created	Private Non-Farm Employment	Totals Job Created
Otter Creek Coal Mine and Tongue River RR	$1 billion	4,388	3,710	8,098
Colstrip Plant Units 1-4	N/A	1,000	2,700	3,700
Montnaa Oil & Gas Industry	N/A	4,500	7,500	12,000
Keystone XLPipeline	$1.1 billion	341	1,420	1,761
Bakken Marketlink, Baker "on ramp"-One time adjustments	$140 million	103.6	157.8	348
Martinsdale Wind Farm	$280 million	18	278	296
Coyote Wind Farm		4	400	404
1000 MW Montana Wind Generation	$1.5 Billion	10,397	9,366	19,763
MATL Related Wind Generation	$2 Billion	130	2,300	2,430
Montana Woody Biomass CHP Project	$20 million	12	N/A	12
Biomass Feasibility Study NW Energy	$53.6 million	43	216	259
BPBE Biomass Feasibility Study	$178 million	555	400	955
MSTI, MATL, NWE Collectors, TransCanada Chinook Line, Grasslands, and NW Upgrades (Colstrip) Combined	4.25 Billion	6,637	N/A	11,648
Total	$10.52 Billion	28,128.6	28,447.8	61,674

2.9 Conclusions

As shown above, energy production has had a dramatic beneficial impact on Montana's economy, generated from various sources that create jobs for and employ thousands of people. The energy resources covered in this study bring millions of dollars in tax revenue to the state and the direct and indirect effects of developing these resources stimulate the economy throughout the area. If Montana didn't take advantage of its' various energy sectors the landscape of the state economy would look much different than it does today.

The energy sectors reviewed in this study are just a small sample of energy development in the state to show the diverse and abundant resources that Montana has to offer when it comes to energy production. Energy production from these sectors has a significant economic impact on the state and its residents, which is only a fraction of overall energy production in the state. Development and promotion of these resources is vital as Montana's economy continues to thrive.

Montana has more potential for energy development from existing and untapped diversified sources than any other state in the nation and if done properly, energy development can create high-quality, good-paying jobs essential for a strong economy. Montana continues to make progress to develop and broaden its energy output which will only continue to benefit the state's economy as a whole. An example of this future development can be seen in the estimated beneficial economic impact underground coal mining will have on the state is shown in the table below.

Table 2-14 Proposed Underground Coal Mines Economic Impacts

Mine Area	Estimated Investment	Estimated Tonnage	Estimated Direct Jobs
Signal Peak	$470 Million	990 Million	300
Carpenter Creek	$250 Million	300 Million	100
Bridger Fromberg	$200 Million	400 Million	150
Pace-American	$300 Million	300 Million	200
Total	$1.225 Billion	1.99 Million	750

Montana energy development can play a key role in helping the US to achieve heightened energy security and positively impact not only the state's economy but the region's economy as well. A case in point is the development of Pacific Northwest ports to ship coal to overseas markets. As of October 2012 there are five coal port development projects being proposed in Washington and Oregon as well as upgrades to three existing coal ports located in Vancouver and Prince Rupert, British Columbia that currently have approximately 50 million tons of coal shipping capacity. Over 100 million tons of expanded coal shipping capacity could be developed in the next 3 to 5 years if the various coal port expansion plans move ahead on schedule.

These coal port projects include the Millennium Bulk Terminal's Longview Washington project and the Morrow Pacific project that will develop coal loading facilities at the Port of Morrow near located near Boardman, Oregon and also at the Port of Westward located near Longview Washington. The Millennium Bulk Terminal is a two phase project with a phase one (2015) coal loading capacity of 25 million tons with a total capacity after completion of phase two of 44 million tons. The Morrow Pacific project plan is to develop up to 8.8 million tons capacity at the Port of Morrow to load covered barges that will move coal down the Columbia River to the Port of Westward where it will be transferred to ocean going vessels for transport to Asian markets. These projects are being developed by coal companies that have operations in Montana. These two projects, when fully built out would create over 4,700 construction jobs and 2,100 long-term operations jobs, according to two consultant prepared economic impact studies that have been completed for the respective projects. While these jobs will be located out of state, according to figures from the Montana coal industry, every million ton increase in annual state coal production will create 10 permanent jobs here at home.

Montana's world class energy resources—coal, hydropower, oil and gas, wind, bioenergy, and geothermal—are second to none in the United States and provide the state with the opportunity to help the nation wean itself from relying on foreign countries to fulfill its energy needs. Proper development of Montana's existing and new diversified energy resources can also provide electric power, gas, and liquid fuels needed to drive economic growth in our state and the nation. Through reports such as this we can gain a better understanding of how important energy development is to Montana's economy and what a positive impact future development can have on the state's workers and citizens.

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